

REMARKS

The claims pending in this Application are claims 1-27 and 32 with claims 13 and 24 being allowed. Independent claims 1, 14, and 26 have been amended. Initially, Applicants thank the Examiner for the courtesies extended in granting the telephonic interview held on December 19, 2007 between Applicants' representative and inventor Brian Moeckly. In that interview, Applicants proposed amended claim language that addressed the § 112, first paragraph rejection. In particular, claims 1, 14, and 26 have been amended to recite the feature wherein the reaction zone contains "negligible amounts of oxygen." As explained in the interview, there is verbatim support for this claimed aspect in the specification. See specification, ¶ [0055]. It was agreed in the interview that this language complied with § 112, first paragraph. Further, one of ordinary skill in the art would recognize the meaning of negligible amounts of oxygen to mean an amount that is so small or de minimis that it would not adversely affect the quality of the thin films.

The Saito et al. and Kim et al. references were further discussed in the interview. Applicants proposed amending language to independent claims 1, 14, and 26 to even more clearly recite that the reaction zone is physically separate from the deposition zone. As seen in Saito et al., a common, carousel-type chamber is employed for the co-sputtering of magnesium and boron targets. It was agreed that the physically separate aspect of the claims distinguished over the Saito et al. prior art reference. In Applicants' claimed method, a physically separate reaction zone that contains pressurized gaseous magnesium produces a localized, high pressure zone of magnesium that enables high quality film growth. The physical separation also aids in excluding oxidative species from the reaction zone, which tends to destroy the quality of films. This physical separation results in higher

quality films than those of Saito et al. For example, the films produced using the claimed method results in high quality MgB_2 films having high T_c values (e.g., 38-39 K) compared to 6-29 K for Saito et al. See e.g., ¶ [0056] of specification and FIGS. 5-6 and Col. 2, line 14 of Saito et al. Moreover, the resistance ratio (RRR) for the films produced in the Saito et al. are ~ 1 while the RRR values for the films produced by the claimed method are ~ 5 . See FIG. 5 (dividing resistivity at 300 K by the resistivity at 40 K). In light of the amendments made herein, it is believed that the claims are patentable over the primary Saito et al. as well as the cited secondary references.

Turning now to the § 103(a) rejections of claims 1-12, 14-23, 25-27, and 32 over Matijasevic et al. in view of Kim et al., Applicant reiterates that the Kim et al. pertains to conventional epitaxial deposition techniques used to form MgB_2 using a template layer. There is no localized high pressure zone of magnesium that reacts with boron. For example, in Kim et al., after sputtering a target of $\text{MgB}_2/\text{Mg}_{1+x}\text{B}_2$ additional Mg is needed to flow over the films to supplement Mg content. Additional post-annealing may also be needed in the method of Kim et al. to achieve the proper stoichiometry. These deficiencies are not present in Applicants' claimed method. During the interview, agreement was reached that Kim et al. related to epitaxial growth methods used to form MgB_2 .

Turning now to Matijasevic et al., during the interview, Applicants reiterated that there was no disclosure or suggestion contained in Matijasevic et al. of using a metallic species, let alone magnesium, within the reaction zone (118). Rather, the device of Matijasevic et al. uses a reaction zone that is charged with an oxidizer or a nitriding agent. Col. 8, lines 18-24 and Col. 3, lines 41-43. Moreover, Applicants discussed the fact that the

inventor of the Matijasevic et al. patent submitted a declaration stating that the reaction zone described in the Matijasevic et al. patent was not intended to be charged with a metallic species. See Dr. Todd Kaplan Declaration¹, ¶ 7. Rather, in the Matijasevic et al. device, the metallic species were reserved for the separate deposition zone. Id. Further, Dr. Kaplan opined that it would not have been obvious to charge a metallic species like magnesium into the reaction zone because metals were reserved for the separate deposition zone and the reaction zone was reserved for gaseous, non-metallic species such as oxygen. Id.

The above facts are important because in the Office Action (e.g., top page 10), reliance was made on the In re King² case to assume that the device of Matijasevic et al. could inherently perform the claimed process. The In re King case holds that a process claim may be anticipated only if the structure in the prior art **necessarily** functions in accordance with the limitations of the method claims in the **normal and usual operation**. As shown above, the normal and usual operation of the Matijasevic et al. device would not involve charging the reaction zone with a metallic species -- let alone charging the reaction zone with magnesium. To the extent the burden has been placed on Applicants to rebut this assumption, the assumption has been readily rebutted by the Applicants. Not only is there no teaching or suggesting of using metallic species in the reaction zone in Matijasevic et al., Applicants' submission of the Declaration from the inventor of the Matijasevic et al. device specifically states that the reaction chamber was not charged with metallic species, nor would such a modification have been obvious.

¹ Previously submitted on July 17, 2007.

² 801 F.2d 1324, 231 U.S.P.Q. 136 (Fed. Cir. 1986).

Applicants would like to further point out that the reaction zone in Matijasevic et al. is designed to keep oxygen inside the reaction zone. This contrasts with the purpose or aim of the reaction zone used in Applicants' claimed process in which oxygen should be **kept out** of the reaction zone. The two reaction zones thus work for opposing purposes -- an indication that it would not be obvious to one of ordinary skill in the art to merely charge the reaction zone of Matijasevic et al. with magnesium.

Moreover, the incorporation of magnesium in the reaction zone is non-obvious given the manner in which an overpressure of magnesium vapor in the reaction zone produces adsorption limited growth of MgB_2 film. In most thin film compounds, the stoichiometric ratio of the resulting film consists of the amount of each evaporated constituent which is present in the deposition system, i.e., the ratio of metallic elements in the film equals the ratio of those evaporants in the deposition system. Putting a metallic species in the pocket is non-obvious because its *rate cannot be controlled* (by deposition monitors) and hence the composition of the film cannot be controlled, meaning that the films will not have the required or desired properties.

MgB_2 , however, is a unique material in that it grows by adsorption limited growth, meaning that so long as a minimum amount of magnesium vapor in the reaction zone is supplied, any excess magnesium vapor will not be incorporated into the growing film, and the ratio of 1 (one) magnesium atom to 2 (two) boron atoms will always occur. The problem with other MgB_2 growth techniques, as discussed in Applicants' specification (see Background), is that a high vapor pressure of magnesium cannot be supplied, particularly at the higher growth temperatures where high-quality thin films are grown. Applicants' claimed method, however, overcomes this problem in a non-obvious way.

Applicants also would like to make two publications of record which, Applicants believe, demonstrate both copying by others as well as the existence of a need in the art for methods of *in-situ* preparation of high quality MgB₂ films. To this end, Applicants have submitted (via an Information Disclosure Statement) a copy of Geerk et al., *In Situ Synthesis of MgB₂ thin films for tunnel junctions*, Appln. Physics Letters Vol. 85, Number 22 (November 29, 2004) and European Patent 1640471A2 (and English Abstract), both of which are not prior art. These publications illustrate that a second, separate group of individuals have investigated an *in situ* synthesis method that, *inter alia*, uses a localized high pressure zone of magnesium for the *in situ* formation of MgB₂. As these publications show, there is a need in the industry for high quality, *in situ* grown MgB₂ films that have high transition temperatures. For example, high transition temperatures (T_c) enable the use of economical compact closed cycle cryocoolers for maintaining operational temperatures. See Geerk et al., first column, lines 1-5. Moreover, Applicants believe that the above-noted Geerk et al. group first learned of Applicants' method in a presentation given by one of the inventors at the December, 2003 Materials Research Society meeting held in Boston, MA.

These publications thus evidence secondary indicia of non-obviousness (copying by others; long-felt but unsolved needs). Applicants submit that these secondary indicia of non-obviousness are further evidence in support of Applicants' contention that the claimed method is not obvious in light of the prior art.

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In light of the amendments and remarks made herein, Applicants believe that the pending claims are allowable over the prior art of record. The Application should be in condition for allowance. If there are any questions concerning this submission, please contact the undersigned at (949) 724-1849 (x. 104).

Respectfully submitted,
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